Differences in Medicare Expenditures During the Last 3 Years of Life

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OBJECTIVE: **To examine age, gender, race, and area income differences in Medicare expenditures in the 3 years before death.**

DESIGN: **Cross-sectional study.**

PARTICIPANTS: **A random sample of aged Medicare beneficiaries who died 1996 to 1999, *N* = 241,047.**

MEASURES: **We estimate differences in mean Medicare expenditures by year before death and by age, gender, race, and area income, adjusting for comorbidities and Medicaid enrollment.**

RESULTS: **Expenditures for blacks are lower in the second and third years before death and are not significantly different from whites in the last year of life (LYOL) (y3 = 70%, *P* < .0001; y2 = 82%, *P* < .0001; LYOL = 119%, *P* = .098). Differences in expenditures between decedents with area incomes over $35,000 compared to under $20,000 attenuate by the LYOL (y3 = 116%, *P* < .0001; y2 = 107%, *P* < .0001; LYOL = 96%, *P* < .0001). Expenditure patterns for women versus men vary by age. Among the younger cohorts (68 to 74 and 75 to 79), expenditures are higher for women in all 3 years before death. This difference attenuates among older cohorts; in the oldest cohort (90+), expenditures for men exceed those for women by 11% in the LYOL (*P* < .0001). Older beneficiaries have higher expenditures in the second and third years before death but lower expenditures in the LYOL. On average, the youngest cohort expended $8,017 more in the LYOL relative to the oldest cohort, whereas in the third year before death, the oldest cohort's expenditures were $5,270 more than those for the youngest cohort (*P* < .0001).**

CONCLUSIONS: **Age-associated differences in aggregate Medicare payments for end-of-life care are more substantial than other differences. The fact that other differences attenuate in the LYOL may reflect having overcome barriers to health care, or reflect an effective ceiling on the opportunities to provide services for persons with overwhelming illness.**

Due to advances in health care and in public health interventions, American adults can expect to live well into their ninth decade. Median life expectancy at birth has reached 79.5 years for women and 73.8 years for men.[1] As a consequence, financing of end-of-life health care largely occurs within Medicare. Services and costs near the end of life have become an important focus of policy and practice. Of the 2.3 million Americans who died in 1997, roughly 2 million (86%) were Medicare beneficiaries.[2] For 2 decades, care in the last year of life has represented over one quarter of Medicare's budget.[2,3] By default, Medicare's financing policies constitute America's public policy on the financing of end-of-life care.

Many studies and reports have documented major disparities in receipt of health care across the lifespan.[4–9] Gender, race, and socioeconomic characteristics mark substantial differences in use of medical care by the elderly and within Medicare specifically.[10–23] However, few studies have examined disparities at the end of life.

We examine age, gender, race, and area income differences in expenditures among Medicare beneficiaries in the 3 years prior to death. Our study expands the framework of end-of-life care studies from the last 12 months of life to the last 3 years of life. Furthermore, while much prior research on end-of-life care relies on data that is 10 to 20 years old[3,24–26] or comes from a limited geographic population,[27,28] this study uses more recent national, population-based data (1993 through 1999).

METHODS

Design

We used linear regression, adjusting for comorbidities, Medicaid enrollment, urban/rural regions, and local health service supply factors to estimate differences in mean total Medicare expenditures in each of the last 3 years of life by age, gender, race, and area income. Data sources included Medicare's 5% sample denominator and claims files for 7 years (1993 through 1999), the Area Resource File for supply variables linked to claims by state and county of beneficiary residence, and the 1990 Census for area income linked to claims by ZIP code of beneficiary residence in their last year of life. This project was reviewed and approved by the RAND Corporation's institutional review board. Patient consent was not required because administrative

claims records were obtained for decedents only. Appropriate data safeguarding plans were established and put in place prior to the start of data analysis.

Setting and Participants

From the 5% sample of aged (65+) Medicare beneficiaries who died between 1996 and 1999 ($N = 265,170$), we excluded end-stage renal disease (ESRD) patients, those eligible for Medicare because of disability, and those in managed care (2.2%). We further excluded those who were not continuously enrolled in both Medicare Part A (Hospital Insurance) and Part B (Supplemental Medical Insurance) for 36 months prior to their death between January 1, 1996 and December 31, 1999 (5.5%). Because the "other" race category comprised a small proportion of our sample (2.0%), we excluded them, retaining only those beneficiaries identified as white or black. Our resulting analytic sample included decedents age 68 and older ($N = 241,047$).

Outcome Measures

The principal outcome measure was total annual Medicare expenditures for each of 3 years prior to death. Medicare expenditures were the sum of inflation-adjusted (to 1999 dollars) Medicare program payments to providers for each of 6 service types: inpatient, outpatient, skilled nursing, home health, hospice, and physician. Deductibles, coinsurance, durable medical equipment, payment by other insurance, and out-of-pocket expenses were not included.

Individual Attributes

Our individual attributes (covariate measures) included age, gender, race, Medicaid enrollment, area income, rural/urban setting, comorbidities, hospital beds, and physician supply. We derived age, gender, race, and Medicaid enrollment from the Medicare Denominator files. Age at death was calculated from dates of birth and death and collapsed into 5 cohorts: 68 to 74, 75 to 79, 80 to 84, 85 to 89, and 90 and older. We categorized race as white or black. Medicaid enrollment reflects any state buy-in to Medicare during the last year of life.

Income in the last part of life is often misleading because so much of available funds is in savings or other nonincome assets. In order to capture socio-economic resources, we used ZIP code–level area income, which reflects differences across neighborhoods in both income and assets. Individual socioeconomic status will be generally associated with area income, with people living in wealthy areas generally having more assets and higher socio-economic status than people living in poorer areas.[29,30] We linked the Medicare Denominator file with ZIP code level census data and obtained the median household income for the beneficiaries' ZIP codes of residence during their last year of life. We defined 3 area income categories: < $20,000, $20,000 to $34,999, and ≥ $35,000. To categorize the county of residence as metropolitan, small urban, or rural,

we linked Urban Influence Codes from the Area Resource File to the Denominator file by state and county of residence.[31]

In order to control for case mix, we developed a count of comorbidities present in the claims for each beneficiary's last 3 years, adapting the method developed by Charlson et al.[32] We screened all claims for mention of 16 comorbid conditions: myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic obstructive pulmonary disease, rheumatoid arthritis, peptic ulcers, chronic liver disease and cirrhosis, diabetes, hemiplegia, quadriplegia, renal failure, malignant neoplasms, metastatic cancer, and AIDS (associated ICD-9-CM codes are available from the authors upon request). We included the number of comorbidities (1 to 16 as a continuous variable) as a control for burden of illness. We also controlled for 2 county level supply factors obtained by linking to the Area Resource File: number of hospital beds and total number of physicians, both as the rate per 1,000 people 65 and older.

Statistical Analysis

We analyzed data using SAS statistical software, version 8.0.[33] Using analysis of variance for unadjusted expenditures, we described differences by gender, race, age, and area income categories within and across each of the last 3 years of life. Due to large sample size, almost all pairwise comparisons were statistically significant at $P < .0001$.

We also estimated mean Medicare program expenditures by age, gender, race, and area income with multivariable regression equations for each of the last 3 years of life, estimating both direct effects of the primary sociodemographic characteristics and interactions, controlling for Medicaid enrollment, comorbidities, metropolitan/small urban/rural county residence, and local supply factors. We tested both first- and second-order interaction terms in the model, but only first-order interactions are presented in this paper. Second-order interactions did not improve the models sufficiently to warrant their inclusion in the final model.

For multivariable analyses, we used the log-transformation of total expenditures for each of the last 3 years of life, adjusting zero expenditures in any year to $1. We evaluated these models by using the χ^2-statistic to test the statistical significance of each individual variable and F-statistics to test the joint significance of each direct effect and its associated interaction term. If the coefficients on the direct effect and the interaction were separately and jointly significant, we concluded that the interaction was important to our understanding of differences in expenditures at the end of life. We report the r^2 statistic for each of the 3 models representing the relationship between sociodemographic characteristics and Medicare expenditures in each of the last 3 years of life. We subsequently used the Duan adjustment to produce the exponentiated parameter estimates in the original dollar scale.[34]

To illustrate differences in expenditures between genders, race, area income groups, and age cohorts, we

calculated ratios of differences in the regression-adjusted mean expenditures for age, race, gender, and area income categories for each of the last 3 years of life, controlling for Medicaid enrollment, urban setting, comorbidities, hospital bed, and physician supply. The ratios used the predicted mean expenditure for each level of the characteristic of interest or interaction (e.g., race and age), holding all other variables in the model constant. We compared blacks to whites by age, women to men by age, higher area incomes to those under $20,000, and older cohorts to the youngest (age 68 to 74). A ratio of 1.0 indicates no difference in expenditures.

RESULTS

Of the 241,047 Medicare decedents in our sample, roughly 20% fall in each of 5 age categories; the mean age at death is 82.8 years (± 7.7) (Table 1). The sample is approximately 58% female and 8% black. About one quarter reside in areas with a median household income of more than $35,000; approximately 20% reside in areas with median household income less than $20,000. About 24% of the sample is Medicaid eligible, 72% reside in metropolitan areas, and 15% reside in rural areas. These characteristics vary by age at death. The older cohorts are disproportionately female and white and are slightly more likely to reside in areas with a median income of more than $35,000.

As shown in Table 2, Medicare expenditures (unadjusted) increase dramatically in the last year of life. The mean total Medicare expenditures in the last year of life approach $24,700, while the mean total Medicare expenditures in years 2 and 3 before death are less than $10,000 per year. Median expenditures are much lower than mean expenditures, illustrating the influence of high-cost cases on the distribution. Less than one percent (0.3%) of decedents had zero expenditures in their last year of life; approximately 4.7% and 6.5% had zero expenditures in their second and third years before death, respectively (data not shown).

In the second and third years before death, women's unadjusted Medicare expenditures exceed those of men; however, men's expenditures are higher than women's in the last year of life. Expenditures for blacks as compared to whites are consistently higher across all 3 years before death. Medicare beneficiaries residing in areas with a median household income above $35,000 have higher expenditures than beneficiaries residing in areas with lower median incomes.

Medicare expenditures during the last year of life decrease with age, and the differences between groups are larger with each successive age cohort. Differences in expenditures by age cohort in the second and third year before death are smaller.

For each of 3 years before death, Table 3 reports linear effects of gender, race, area income, and age on the log of total Medicare expenditures after controlling for urban/nonurban metropolitan/rural county residence, Medicaid enrollment, comorbidities, and supply factors. Positive

Table 1. Descriptive Characteristics of Study Sample*

Variable	All Ages (*N* = 241,047)	Age at Death				
		68 to 74 (*N* = 44,986)	75 to 79 (*N* = 46,981)	80 to 84 (*N* = 52,746)	85 to 89 (*N* = 48,773)	90+ (*N* = 47,561)
White female, %	52.8	40.8	44.4	50.6	58.6	69.3
White male, %	39.2	49.4	46.9	42.0	34.4	23.6
Black female, %	4.7	4.7	4.5	4.3	4.5	5.4
Black male, %	3.3	5.1	4.3	3.1	2.6	1.8
Area income, %						
< $20,000	19.6	20.9	20.1	19.2	19.0	18.6
$20,000–$35,000	55.1	56.4	55.6	55.4	54.6	53.6
> $35,000	25.3	22.7	24.2	25.4	26.4	27.8
Medicaid enrollment, %	23.7	19.0	19.2	20.8	25.9	33.6
Region, %						
Metropolitan	71.8	70.5	71.9	71.8	72.4	72.4
Small urban	13.4	14.0	13.5	13.4	13.0	12.9
Rural	14.8	15.5	14.6	14.8	14.6	14.7
Mean comorbidities (± SD)[†]	3.4 (1.9)	3.5 (2.0)	3.6 (2.0)	3.5 (1.9)	3.4 (1.8)	3.0 (1.7)

* *All relationships are statistically significant at* P < .0001.

[†] *Range: 0 to 16. SD, standard deviation.*

Table 2. Unadjusted Mean and Median Medicare Expenditures for the Last 3 Years of Life*

| | Expenditures by Year Before Death, $[†] | | | | | |
| | Year 1 | | Year 2 | | Year 3 | |
	Mean (SD[†])	Median	Mean (SD[†])	Median	Mean (SD[†])	Median
All Beneficiaries	24.6 (27.7)	17.0	9.4 (15.8)	2.5	7.3 (13.5)	1.5
Gender						
Female	23.6 (26.7)	16.1	9.6 (16.0)	2.5	7.6 (13.6)	1.6
Male	26.0 (28.9)	18.2	9.1 (15.6)	2.4	6.9 (13.3)	1.4
Race						
Black	31.8 (34.1)	22.3	11.2 (18.3)	3.2	8.5 (15.6)	1.6
White	24.0 (27.0)	16.6	9.2 (15.6)	2.4	7.8 (13.3)	1.5
Area Income, $						
< 20,000	25.0 (27.8)	17.5	9.7 (15.7)	2.8	7.5 (13.3)	1.6
20,000–35,000	23.5 (26.4)	16.2	8.9 (15.2)	2.3	6.9 (12.9)	1.4
> 35,000	26.8 (30.1)	18.5	10.2 (17.1)	2.6	7.9 (14.7)	1.7
Age at Death, y						
68 to 74	30.6 (33.2)	21.8	10.1 (17.8)	2.3	7.2 (14.9)	1.1
75 to 79	28.7 (31.0)	20.6	10.0 (16.9)	2.7	7.5 (14.3)	1.5
80 to 84	25.3 (27.1)	18.1	9.7 (15.8)	2.8	7.6 (13.9)	1.7
85 to 89	21.9 (23.6)	15.6	9.2 (14.5)	2.7	7.3 (12.8)	1.8
90+	16.7 (19.6)	10.8	7.9 (13.9)	2.0	6.7 (11.3)	1.5

* *Group differences in expenditures are statistically significant at* P < .0001.
† *In thousands per beneficiary.*
‡ *SD, standard deviation.*

coefficients indicate characteristics associated with higher Medicare expenditures relative to the reference group.

In the adjusted model, women's total mean expenditures are higher than men's for each of the last 3 years of life, although the coefficient on the main effect is smaller for the last year of life than for expenditures 2 and 3 years before death, suggesting the difference in expenditures diminishes in the last year of life. Black women's expenditures

Table 3. Multiple Linear Regression Results on the Log of Medicare Expenditures, by Year Before Death*[†‡]

| | Year Before Death | | | | | |
| | Year 1 (Last Year) | | Year 2 | | Year 3 | |
	Coefficient (SE)	P Value	Coefficient (SE)	P Value	Coefficient (SE)	P Value
Intercept	7.85 (0.012)	< .0001	5.24 (0.016)	< .0001	5.22 (0.020)	< .0001
Female	0.30 (0.013)	< .0001	0.46 (0.019)	< .0001	0.57 (0.023)	< .0001
Black	−0.04 (0.024)	.10	−0.40 (0.035)	< .0001	−0.56 (0.043)	< .0001
Income $20,000 to $35,000	−0.08 (0.008)	< .0001	−0.04 (0.011)	.002	−0.03 (0.013)	.044
Income > $35,000	−0.05 (0.009)	< .0001	0.07 (0.014)	< .0001	0.15 (0.017)	< .0001
Age 75 to 79	−0.01 (0.013)	.27	0.13 (0.019)	< .0001	0.34 (0.023)	< .0001
Age 80 to 84	−0.02 (0.013)	.07	0.25 (0.019)	< .0001	0.55 (0.023)	< .0001
Age 85 to 89	−0.06 (0.014)	< .0001	0.33 (0.020)	< .0001	0.66 (0.024)	< .0001
Age 90+	−0.16 (0.015)	< .0001	0.37 (0.023)	< .0001	0.64 (0.027)	< .0001
Female* Age 75 to 79	−0.09 (0.018)	< .0001	−0.07 (0.026)	.011	−0.16 (0.032)	< .0001
Female* Age 80 to 84	−0.18 (0.017)	< .0001	−0.17 (0.026)	< .0001	−0.32 (0.031)	< .0001
Female* Age 85 to 89	−0.27 (0.018)	< .0001	−0.19 (0.027)	< .0001	−0.36 (0.032)	< .0001
Female* Age 90+	−0.42 (0.019)	< .0001	−0.30 (0.028)	< .0001	−0.41 (0.034)	< .0001
Female* Black	0.02 (0.021)	.29	0.09 (0.031)	.0050	0.28 (0.038)	< .0001
Black* Age 75 to 79	0.09 (0.031)	.004	0.11 (0.045)	.0129	−0.10 (0.055)	.08
Black* Age 80 to 84	0.19 (0.031)	< .0001	0.14 (0.046)	.0023	0.06 (0.056)	.29
Black* Age 85 to 89	0.28 (0.032)	< .0001	0.20 (0.048)	< .0001	0.03 (0.058)	.56
Black* Age 90+	0.42 (0.033)	< .0001	0.31 (0.048)	< .0001	0.23 (0.059)	< .0001
r^2	0.31		0.07		0.06	

* *The relationship between the variables of interest and the log of Medicare expenditures are estimated using least squares regression; coefficients, standard errors (SE), and P values are presented.*
† *The omitted category for area income is < $20,000; the omitted category for age is 68 to 74.*
‡ *These models controlled for any Medicaid use in the LYOL, comorbidities, urban/nonurban metropolitan/rural region of residence, the number of hospital beds per 1,000 population over 65, and the number of physicians per 1,000 population over 65.*

appear to be higher than white women's expenditures in years 2 and 3 before death; however, this effect disappears in the last year of life. Additionally, age appears to modify the effect of gender on the log of expenditures; in each year before death, the difference in expenditures between men and women decreases as the age of the cohort increases. The difference in expenditures declines with older decedent cohorts; among those 85 to 89, women's and men's expenditures in their last year of life are not statistically different.

After adjusting for other important characteristics, expenditures in years 2 and 3 before death are higher among older cohorts when compared to the youngest cohort (68 to 74). In the last year of life, this pattern of expenditures reverses; older cohorts have progressively lower expenditures. Expenditures for the 2 oldest age cohorts (85 to 89 and 90+) are significantly lower than those for the youngest age cohort.

On average, expenditures for blacks are lower than those for whites in the second and third year before death; however, in the last year of life, expenditures by race overall are not statistically different. The effect of age on the log of Medicare expenditures is significantly modified by race among older cohorts. In the third year before death, expenditures for blacks are moderately higher than for whites age 90+. In the second year before death, we find large differences in expenditures with more spent on blacks. This difference increases with each age cohort. In the last year of life, while average expenditures are smaller for older cohorts relative to the youngest cohort, expenditures for older blacks (85 to 89 and 90+) are still larger relative to the youngest decedent cohort.

Expenditures in years 2 and 3 before death are higher on average for those residing in areas with the highest median household income, as compared to those in areas with the lowest income. Mean expenditures for those in the wealthiest areas are 16% higher in the third year before death ($P < .0001$) and 7% higher in the second year before death ($P < .0001$). The pattern of differences in expenditures between the highest and the lowest income areas narrows and reverses in the last year of life; expenditures for beneficiaries residing in the lowest income areas are 4% higher than for those residing in the highest income areas ($P < .0001$) (data not shown). The variance explained by the regression models varies by year before death. The largest variance explanation, represented by the r^2 statistic, comes from the last year of life (31%). The larger r^2 value in the last year of life suggests that personal characteristics have greater influence on use of Medicare services in the last 12 months of life than in prior years; other factors not included in the model may be more important in understanding expenditures in the years prior to the last year of life.

Figure 1 presents the ratios of regression-adjusted mean Medicare expenditures by age cohort and year before death. Expenditures in years 2 and 3 before death are higher for older decedents. In the last year of life, this pattern is reversed: expenditures for the age 85 to 89 decedent cohort are 17% lower ($P < .0001$) than those for the youngest cohort, and expenditures for the age 90 and older decedent cohort are 31% lower ($P < .0001$).

Figure 2 presents the ratios of regression-adjusted mean Medicare expenditures by gender and age cohort. Expenditures for women are higher than for men overall;
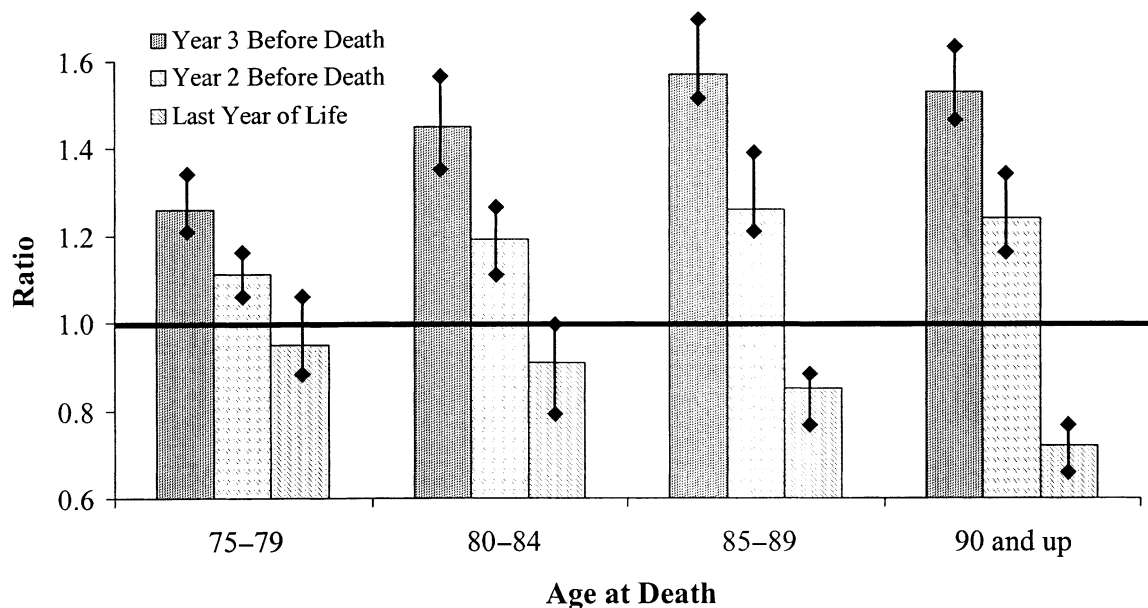

FIGURE 1. Ratio of regression-adjusted mean Medicare spending, in the last 3 years of life, by age at death.*†
* Reference group for all ratios is the 68 to 74 age cohort. Regression-adjusted means were calculated for each beneficiary characteristic, controlling for other characteristics. Ratios were calculated by dividing mean expenditures for older cohorts by mean expenditures for the 68 to 74 age cohort. The bar in the figure is set at 1.0, reflecting no difference in expenditures.
† Ninety-five percent of confidence intervals presented for each ratio.
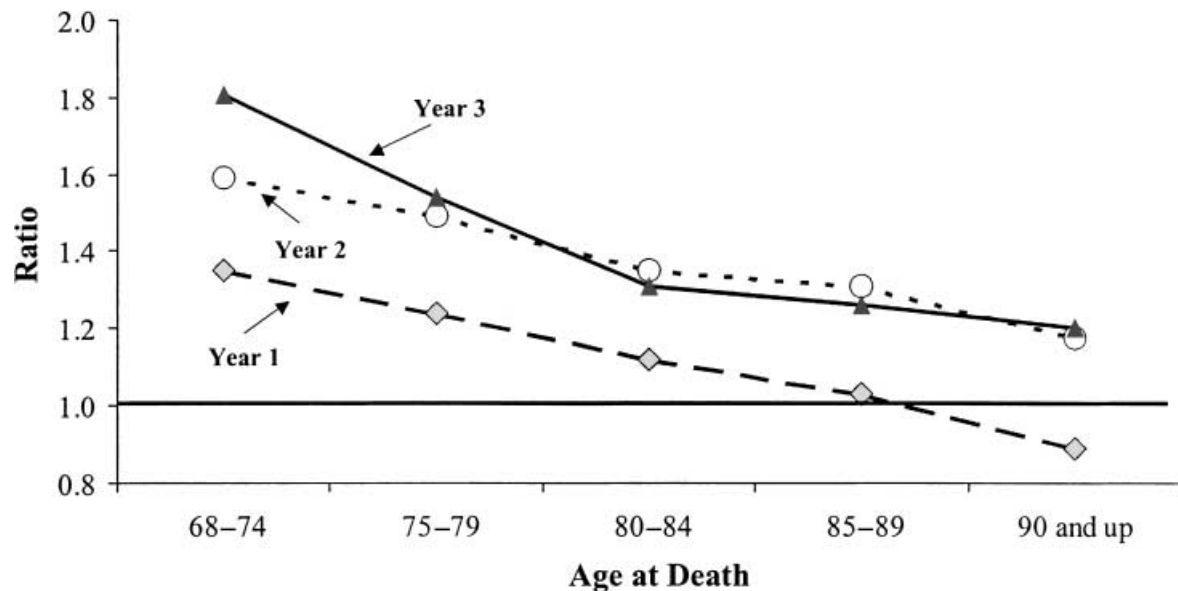
FIGURE 2. Ratio of regression-adjusted mean Medicare expenditures for women as compared to men in the last 3 years of life, by age at death.*[†]

* Regression-adjusted means were calculated for each beneficiary characteristic, controlling for other characteristics. Ratios calculated by dividing mean expenditures for women by mean expenditures for men within each age cohort. The bar in the figure is set at a ratio of 1.0, reflecting no difference in expenditures.

[†] Ratios are statistically significant at P < .01, with the exception of the ratio of expenditures for the 85 to 89 age cohort, in the last year of life (95% confidence internal (CI) 1.00 to 1.11).

however, the ratio of expenditures for women and men partially reverses in the last year of life. In years 2 and 3 before death, expenditures are consistently higher for women than for men, although the effect is smaller among the older decedent cohorts. In the last year of life, expenditures for women are higher than for men in the 3 youngest decedent cohorts. However, the ratio of expenditures for men and women age 85 to 89 is very close to 1.0. Among those age 90 and older at death, expenditures are approximately 11% higher for men than for women.

Figure 3 presents the ratios of regression-adjusted mean Medicare expenditures by race and age group. Expenditures for blacks were lower than those for whites in years 2 and 3 before death; however, the differences were largest in the younger cohorts and not significantly different among the oldest decedent cohorts. In the last year of life, the ratio of expenditures for blacks to whites is reversed; more is expended on blacks that whites in the older age cohorts (80+).

DISCUSSION

Payment differences on the basis of gender, race, and area income generally narrow in the last 3 years of life. Differences on the basis of age persist; however, the direction of the difference changes in the last year of life, where expenditures on older cohorts decline relative to the youngest cohort. This pattern of findings on the basis of age in the last year of life is consistent with other study findings.[27,35]

This study is the first population-based study to identify a set of circumstances in which overall investments in health care are not substantially different by race, area income, and gender. Exploration of how these findings arise might help efforts to reduce widely found differences in other populations. Several possibilities might explain the absence of serious differences by race, gender, or area income in the last year of life. Perhaps the combination of nearly universal Medicare coverage for the elderly and having serious illnesses in the last year of life overcomes some of the usual barriers to health care.[36,37] Differences in aggregate expenditures might also narrow if services are mostly supportive or they are approaching a maximum feasible utilization. Mean Medicare expenditures in the last year of life ($24,000) vary little by principal diagnosis or cause of death.[38] Perhaps on average, what service health care providers can give during a year of serious illness effectively reaches a "saturation point." Or perhaps the typical patient becomes sick enough to make high-cost treatments inappropriate, in which case there are fewer high-cost treatments that might create evidence of disparities.[39] Discerning the underlying cause of these findings could improve the understanding of differences in spending and utilization generally, as well as the understanding of payment and organization of care for those approaching the end of life specifically.

While private supplemental insurance and even Medicaid can positively influence total health care expenditures among healthy beneficiaries (reducing the amount paid
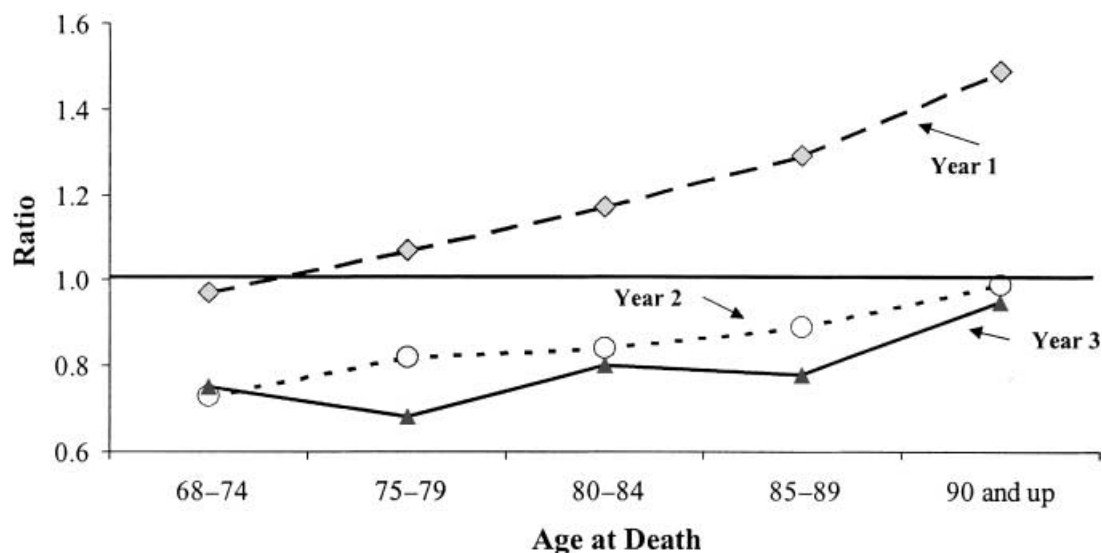
FIGURE 3. Ratio of regression-adjusted mean Medicare expenditures for blacks as compared to whites in the last 3 years of life, by age at death.*[†]

* Regression-adjusted means were calculated for each beneficiary characteristic, controlling for other characteristics. Ratios calculated by dividing mean expenditures for blacks by mean expenditures for whites within each age cohort. The bar in the figure is set at a ratio of 1.0, reflecting no difference in expenditures.

[†] Ratios for blacks versus whites are statistically significant at $P < .01$, with the exception of the ratio for those age 68 to 74 in the last year of life (95% CI, 0.94 to 1.01), age 75 to 79 in the last year of life (95% CI, 1.00 to 1.14), age 85 to 89 in the second year before death (95% CI, 0.77 to 1.00), age 90+ in the second year before death (95% CI, 0.86 to 1.11), and age 90+ in the third year before death (95% CI, 0.75 to 1.09).

out-of-pocket, thus reducing barriers to care),[40] there is some evidence to suggest that this relationship is weakened among those with significant illness and disability.[41] Furthermore, while hospice use varies nationally,[42] recent analyses suggest that hospice care does not reduce total expenditures for most users.[43] Blacks are less likely than whites to have advance directives, suggesting their expenditures would be higher at the end of life.[44] However, advance directives may have little influence,[45] in part because many are not implemented or are not decisive in the situation.[46–48]

Our analyses have several limitations. Although the study sample is not substantially different from the larger Medicare decedent population, the findings cannot be generalized to other populations (e.g., younger decedent populations, decedents in Medicare managed care, and populations not covered by Medicare). We addressed differences in mean expenditures across groups; however, there is great within-group variation in expenditures. Further research could explain how high-cost cases influence differences in total expenditures. This study employed ZIP code level data on income, so we cannot examine possible associations between individual income and Medicare expenditures.[29,30] Subsequent analyses might use survey data such as the Medicare Current Beneficiary Survey to study the association between individual-level income and Medicare expenditures data. Finally, a small proportion of the sample has zero or very small expenditures, which could be accurate or could arise from billing mistakes or accessing care not covered by Medicare (i.e., Veterans'

Health Administration). We are unable to distinguish among those reasons for zero and low expenditures in our sample, which could have an important influence on our findings.

Our analyses have focused on differences in aggregate expenditures. Further analyses could illuminate the composition of services received by various groups. Furthermore, our data do not reflect all health care expenditures. Differences by age in the last year of life might disappear or even reverse if the data included nursing facility costs.[49] Our findings also do not address variation in quality of care received at the end of life. Previously identified poor quality care near death[38,48,50] might correlate with patient characteristics.

The conclusion drawn from this paper—that differences in Medicare expenditures by gender, race, and area income become small or disappear in the last year of life—greatly differs from previously cited reports of differences in health care utilization and expenditures at other points along the life course. Policy should not assume that gender, race, and area income differences persist at the end of life; however, considerable disparities may yet exist in the array of services accessed or the quality of end of life care. Additional research should yield insights as to why the differences observed farther from death narrow in the last year and as to whether these patterns occur in other cohorts at the end of life.

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